SUBSTITUTE SPECIFICATION

D E S C R I P T I O N

MOTOR UNIT INCLUDING INTEGRATED MOTOR AND SPEED REDUCTION MECHANISM

Technical Field

[0001] The present invention relates to a motor unit integrating a motor with a speed reduction mechanism or a control circuit. More particularly, the invention relates to a motor unit to be used as a drive source of, e.g., a wiper or slide door of an automobile.

Background Art

[0002] Conventionally, in a windshield wiper unit for wiping the front glass of a car, a system that activates a wiper arm by a link mechanism with a motor used as a drive source has been widely employed. As the function of the wiper system becomes more refined, a system that electrically controls a motor to thereby control the wiper movement has widely appeared in recent years in place of the above link drive system. In this motor control drive system, a configuration in which a control circuit and motor are integrated with each other is adopted in terms of product modulation or the like. For example, as disclosed in PCT Application Laid-open Publication No. 2002-511038, a motor is mounted in an automobile as a unit including a speed reduction mechanism.

[0003] In such a motor unit, however, a control circuit section is two-dimensionally arranged in a housing, and circuit components are two-dimensionally placed on the control circuit section, thereby

increasing an area occupied by the mounted circuit components. Further, in the control circuit section, power system components such as a power MOSFET and relay, are all arranged on the printed wiring board, so that the width of a copper-foil pattern must be widened on the printed wiring board according to the current amount, correspondingly increasing the board size. It is desirable that the power system components be arranged on the large-sized printed wiring board in consideration of the heat radiation properties thereof. Even in view of this, the board size tends to be increased. Accordingly, the size of the control circuit section is likely to be increased for these reasons to thereby increase the size of the motor unit. The larger the size of the motor unit, the larger the size of the required mounting space for the unit to be provided on the automobile side becomes, and this problem does need to be solved.

[0004] An object of the present invention is to reduce the space occupied by the control circuit section in the motor unit to reduce the size of the entire motor unit.

Summary of the of Invention

[0005] A motor unit according to the present invention integrally comprises a motor and a drive control section having a control circuit for driving the motor. The unit is characterized in that the drive control section includes: a first circuit component containing section; a second circuit component containing section three-dimensionally arranged with respect to the first circuit component containing section; and a connecting line arranged

between the first and second circuit component containing sections.

[0006] In the present invention, the drive control section has a three-dimensional structure including the first and second circuit component containing sections, so that it is possible to arrange circuit components in a three-dimensional manner to reduce the planar size (area) of the drive control section and thereby to contain circuit components for motor drive control in the small space. Therefore, it is possible to reduce the size of the motor unit, as compared to a conventional motor unit, as well as to reduce the mounting space on the automobile side. Further, since the noise generated from the circuit components of the containing sections is absorbed by the connecting line, it is possible to obtain a motor having improved accuracy in responsiveness or the like.

[0007] In the motor unit, the first circuit component containing section may include a printed wiring board, and the second circuit component containing section may include circuit components electrically connected to the printed wiring board through the connecting line. Further, in the motor unit, the printed wiring board and the circuit components arranged in the second circuit component containing section may be arranged substantially in parallel with each other, with the connecting line interposed therebetween. With the above configuration, the circuit components can be arranged with improved space efficiency.

[0008] Further, in the motor unit, a configuration may be employed in which signal system circuit components are arranged in the first circuit component containing section and power system circuit

components are arranged in the second circuit component containing section. With the above configuration, the amount of current flowing through the printed wiring board arranged in the first circuit component containing section can be reduced. The area of a copper-foil pattern can accordingly be reduced to reduce the size of the wiring board. In this case, the power system circuit components may directly be mounted on the connecting line.

[0009] In addition, in the motor unit, the second circuit component containing section may be arranged on the outer surface side of the unit with respect to the first circuit component containing section. With the above configuration, the power system circuit components can be arranged on the open air side. Therefore, the heat generated from the power system circuit components can effectively be radiated to the air. In this case, a configuration may be allowable in which a heat sink is provided outside the second circuit component containing section to further increase heat radiation properties.

[0010] Further, the motor unit may include the motor; a case frame which contains a speed reduction mechanism of the motor; and a cover assembly which is fitted to the case frame and contains the drive control section.

[0011] In this case, the cover assembly may have a two-chamber structure in which the first and second circuit component containing sections are arranged three-dimensionally in the upper and lower directions or may have a dividing wall that sections the first and second circuit component containing sections. Further, the dividing wall may have a connecting hole which communicates the

first and second circuit component containing sections.

[0012] Further, the cover assembly may include: a bottom case which has the dividing wall, the first circuit component containing section being formed at the portion between the dividing wall, and the case frame; and a case cover which is fitted to the bottom case. In this case, the second circuit component containing section being formed between the case cover and the dividing wall.

[0013] In addition, the power system circuit components may be fixed to the inner surface of the case cover and the case cover may include a plurality of fins on the outer surface side thereof. Further, black alumite treatment may be applied to the outer side surface of the case cover, which is made of aluminum.

Brief Description of Drawings

[0014] FIG. 1 is an explanatory view showing the configuration of a motor unit according to an embodiment of the present invention;

[0015] FIG. 2 is an explanatory view showing the internal configuration of a cover assembly;

[0016] FIG. 3 is a plan view of a bottom case, viewed from above in FIG. 2, showing a state in which a heat sink has been removed from the bottom case;

[0017] FIG. 4 is a bottom view of the bottom case, viewed from below in FIG. 2;

[0018] FIG. 5 is a perspective view of the bottom case, showing the upper surface side of the bottom case in FIG. 2; and

[0019] FIG. 6 is a perspective view of the bottom case, showing the lower side surface of the bottom case in FIG. 2.

Detailed Description of the Invention

[0020] An embodiment of the present invention will be described below in detail with reference to the accompanying drawings. FIG. 1 is an explanatory view showing the configuration of a motor unit according to an embodiment of the present invention. A motor unit 1 of FIG. 1 is used as a drive source of a windshield wiper unit for an automobile and integrally includes an electric motor 2, a speed reduction mechanism section 3, and a drive control section 4. A rotation output of the electric motor 2 is decelerated in the speed reduction mechanism section 3 and drives a wiper mechanism (not shown).

[0021] The electric motor 2 is constituted by a stator 10 and a rotor 11. The stator 10 has a yoke 12 having a closed-bottomed cylindrical shape, a permanent magnet 13 fixed on the inner circumferential surface of the yoke 12, a brush 14, and a brush holder 15 which retains the brush 14. Provided on the rotor 11 side are a motor shaft 16 rotatably supported in the stator 10, an armature core 17 fixed to the motor shaft 16, a coil 18 wounded around the armature core 17, and a commutator 19 fixed to the motor shaft 16 at the lateral side of the armature core 17.

[0022] A case frame 21 is integrally attached to the edge portion of the yoke 12 on the opening side thereof. The brush holder 15 is fixed by a screw 22 to the lateral end portion of the case frame 21. The brush 14 is supported by the brush holder 15 so as to be movable in the inner and outer diameter directions thereof. The brush 14 is biased by a spring 23 toward the commutator 19 to be

pressed against the commutator 19. The above basic structure is the same as that of a conventional motor commonly used.

[0023] The speed reduction mechanism section 3 is provided within the case frame 21. The speed reduction mechanism section 3 decelerates the rotation of the motor shaft 16 in order to output the rotation. The speed reduction mechanism section 3 is constituted by a gear-reduction mechanism and includes a worm 24, a worm-wheel 25, a first gear 26, and a second gear 27 to decelerate the rotation of the motor shaft 16, and includes a drive shaft 28 to output the rotation. The distal end portion of the motor shaft 16 projects inside of the case frame 21 from the yoke 12, where a pair of worms 24a and 25b furnished with thread grooves running in the opposite directions to each other are formed. The worm 24a is engaged with the worm-wheel 25 rotatably supported in the bottom surface portion of the case frame 21. The worm 24b is engaged with another second worm-wheel (not shown) formed in pairs with the worm-wheel 25.

[0024] The first gear 26 having a small diameter is integrally and coaxially arranged with the worm-wheel 25. The first gear 26 is engaged with the second gear 27 having a large diameter. The second gear 27 is fixed to the drive shaft 28 rotatably supported in the bottom surface portion of the case frame 21. A small-diameter first gear is also integrally formed with the second worm-wheel (not shown) and engaged with the second gear 27. The drive shaft 28 projects from the bottom portion of the case frame 21 and is linked to a wiper mechanism (not shown). A seal rubber 29 is attached to the bottom portion of the case frame 21 so as to cover

the drive shaft 28. The rotation of the motor shaft 16 is transmitted, while being decelerated, through the worms 24a and 24b, worm-wheel 25, second worm-wheel, first gear 26, first gear, and second gear 27, and reaches the drive shaft 28 to activate the windshield wiper unit.

[0025] A cover assembly 30 containing the drive control section 4 is provided on the upper side (in FIG. 1) of the case frame 21. FIG. 2 is an explanatory view showing the internal configuration of the cover assembly 30. The cover assembly 30 is constituted by a bottom case 31 made of synthetic resin, and a heat sink (case cover) 32 made of aluminum die-casting. FIG. 3 is a plan view of the bottom case 31, viewed from above in FIG. 2, showing a state in which the heat sink 32 has been removed from the bottom case 31. FIG. 4 is a bottom view of the bottom case 31, viewed from below in FIG. 2. FIGS. 5 and 6 are perspective views of the bottom case 31. FIG. 5 shows the upper surface side of the bottom case 31 in FIG. 2, and FIG. 6 shows the lower surface side of the bottom case 31 in FIG. 2.

[0026] The bottom case 31 has a two-chamber structure in which two circuit component containing sections 33 (first) and 34 (second) are arranged three-dimensionally in the upper and lower directions. A dividing wall 35 is formed between the upper and lower circuit component containing sections 33 and 34 to separate them from each other. A connecting hole 36 which allows the containing sections 33 and 34 (to communicate) is appropriately formed in the dividing wall 35. A metal bus bar (connecting line) 37 is wired through the connecting hole 36 to electrically connect the containing sections

33 and 34. As shown in Figures 1 and 2, the first circuit component containing section 33 is arranged so as to face the speed reduction mechanism section 3, while the second circuit component containing section 34 faces the case cover (heat sink) 32.

[0027] A printed wiring board 38 mounting signal system chip components, condenser 39, and the like are contained in the lower side circuit component containing section 33 (first circuit component containing section). Mounted on the printed wiring board 38 are a rotation sensor 40 which detects the rotation of the motor shaft 16, a position sensor 41 which detects the rotation angle of the drive shaft 28 to detect the position of wiper blades, and the like. A rotation detection sensor magnet 42 is attached to the motor shaft 16 so as to correspond to the rotation sensor 40 and thereby a pulse signal is output from the rotation sensor 40 when the motor shaft 16 is rotated. Further, a position detection sensor magnet 43 is attached to the second gear 27 so as to correspond to the position sensor 41 and thereby an absolute position (e.g., lower reversal position) of the wiper blades is detected by the potion sensor 41. In addition, by counting the pulse signal from the rotation sensor 40, it is possible to grasp the shift amount of the wiper blades from the absolute position thereof. As a result, the current position of the wiper blade can accurately be detected.

[0028] Contained in the upper side circuit component containing section 34 (second circuit component containing section) are power system circuit components such as a FET 44, relay 45, diode 46, and condenser 47. The bus bar 37 electrically connected to the printed

wiring board 38 is wired in the second circuit component containing section 34. Discrete components such as the FET 44 are directly mounted on the bus bar 37. A broad metal plate is used for the bus bar 37 in accordance with the amount of current flowing in the power system circuit components. Respective bus bars 37 are fixed by epoxy based resin to be insulated with each other.

[0029] The heat sink 32 also serving as a cover is fitted to the upper surface of the bottom case 31. The FET 44 is fixed by a screw 48 to the inner surface of the heat sink 32. The upper surface 44a of the FET 44 directly comes into contact with the inner surface 32a of the heat sink 32. A plurality of fins 49 are formed on the outer surface side of the heat sink 32. The heat generated in the FET 44 is directly transmitted to the heat sink 32, passed through the fins 49 and the like, and is immediately radiated from the outer surface of the heat sink 32. Incidentally, black alumite treatment has been applied to the heat sink 32 in order to increase heat radiation properties.

[0030] As described above, the bottom case 31 has a three dimensional two-chamber structure in which circuit components are arranged in a stacked manner, so that it is possible to reduce the planar size (area) of the drive control section 4 and thereby to contain circuit components for motor drive control in the small space. Therefore, it is possible to reduce the size of the motor unit, as compared to a conventional motor unit, as well as to reduce the mounting space on the automobile side. Further, in the bottom case 31, the printed wiring board 38 and discrete components such as the FET 44 are arranged substantially in parallel with each

other, with the bus bar 37 interposed therebetween, so that the circuit components are arranged with improved space efficiency in the bottom case 31.

[0031] Further, when the bus bar 37 is wired to allow the containing sections 33 and 34 to communicate, the power system circuit components are mounted on the bus bar 37, and only the signal system circuit components are mounted on the printed wiring board 38. Therefore, the amount of current flowing through the wiring board can be reduced. As a result, the area of a copper-foil pattern on the wiring board can be reduced, correspondingly miniaturizing the wiring board size. Therefore, combined with the two-chamber structure, it is possible to further reduce the size of the motor unit. Further, since the noise generated from the circuit components of the containing sections 33 and 34 is absorbed by the bus bar 37, it is possible to improve responsiveness or the like to increase motor control accuracy.

[0032] On the other hand, in the drive control section 4, the signal system sensor components are arranged in the motor shaft 16 side circuit component containing section 33, and the power system circuit components are arranged in the circuit component containing section 34 positioned on the outer surface side of the bottom case 31. That is, the power system circuit components are arranged in the open air side, so that the heat generated from the power system circuit components can effectively be radiated to the air. Further, the heat sink 32, which serves also as a cover of the bottom case 31, is provided on the rear side of the power system circuit components, so that heat radiation properties can further be

increased.

[0033] As described above, according to the present invention, in the motor unit integrating a motor and drive control section, the drive control section has a three-dimensional structure including a first and second circuit component containing sections, the containing sections being connected to each other by a connecting line. Therefore, it is possible to arrange circuit components in a three-dimensional manner to reduce the planar size (area) of the drive control section and thereby to contain circuit components for motor drive control in the small space. Therefore, it is possible to reduce the size of the motor unit, as compared to a conventional motor unit, and to reduce the mounting space on the automobile side. Further, since the noise generated from the circuit components of the containing sections is absorbed by the connecting line, it is possible to obtain a motor having improved accuracy in responsiveness or the like.

[0034] Further, according to the motor unit of the present invention, a printed wiring board arranged in the first circuit component containing section and circuit components arranged in the second circuit component containing section are arranged substantially in parallel with each other, with the connecting line interposed therebetween. Thus, the circuit components can be arranged with improved space efficiency. As a result, it is possible to reduce the size of the entire motor unit.

[0035] Further, according to the motor unit of the present invention, signal system circuit components are arranged in the first circuit component containing section and the power system

circuit components are arranged in the second circuit component containing section, so that the amount of current flowing through the printed wiring board arranged in the first circuit component containing section can be reduced. Accordingly the area of a copper-foil pattern on the wiring board can be reduced according to the current amount to reduce the size of the wiring board, thereby miniaturizing the motor unit.

[0036] In addition, according to the motor unit of the present invention, the second circuit component containing section is arranged in the open air side of the unit with respect to the first circuit component containing section, so that the power system circuit components can be arranged on the open air side. Therefore, the heat generated from the power system circuit components can effectively be radiated to the air. Further, a heat sink is provided outside the second circuit component containing section, so that heat radiation properties can be further increased.

[0037] It goes without saying that the present invention is not limited to the above embodiment, and various changes may be made without departing from the scope of the invention.

[0038] For example, not only the signal system circuit components, but also the power system circuit components can appropriately be mounted on the printed wiring board 38. Further, in the above embodiment, the bottom case 31 has a three-dimensional two-chamber structure. Alternatively, however, the bottom case 31 may have a three-dimensional three or more-chamber structure. Further, a chamber like mezzanine may be provided in the bottom case 31.

[0039] Further, in the above embodiment, the motor unit of the

present invention is used as a drive source of a windshield wiper unit. Alternatively, however, the motor unit according to the present invention is also applicable to a drive source of a car tailgate, slide door, power window, sunroof, and the like. In addition, the motor unit of the present invention is applicable not only to an automobile, but to various types of electric apparatus that uses a motor as a drive source. While the motor unit includes the speed reduction mechanism section 3 in the above embodiment, the present invention can be applied to the motor unit that does not include the speed reduction mechanism section 3.

Industrial Applicability

[0040] As described above, the motor unit according to the present invention is effectively applied not only to a motor unit used as a drive source of, e.g., a windshield wiper or slide door of an automobile, but also to a drive source of various electric apparatus, such as a motor unit used for the portion the size of which needs to be reduced.